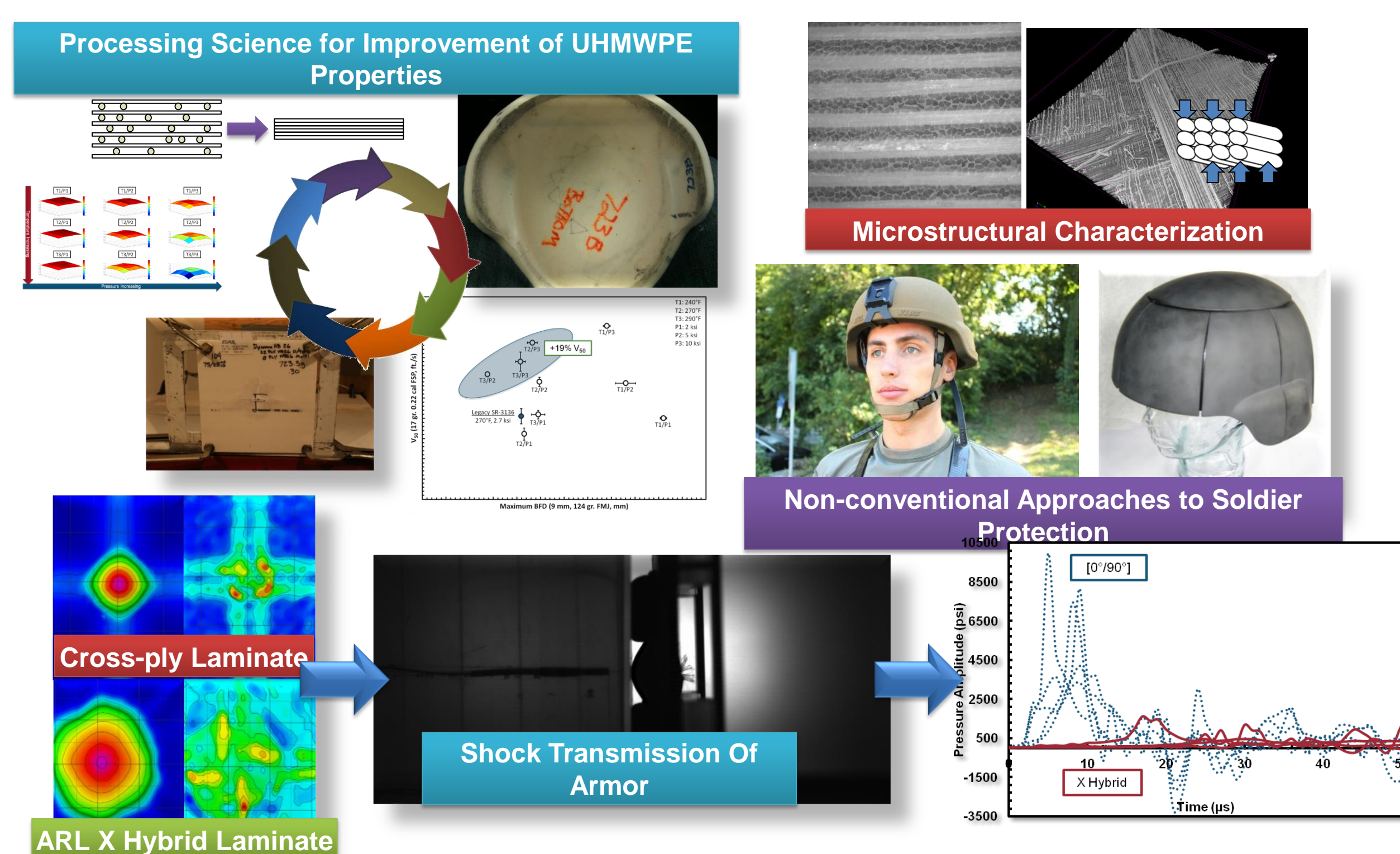


## S&T Campaign: Materials Research Manufacturing Science Advanced & Additive Manufacturing

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## Research Objective

Identify and exploit novel ballistic and impact response mechanisms in Soldier protection equipment using state-of-the-art materials, processing science, and hybridization/architecture; Explore influence on stress transmission response to develop mitigation techniques for behind armor blunt trauma (BABT)



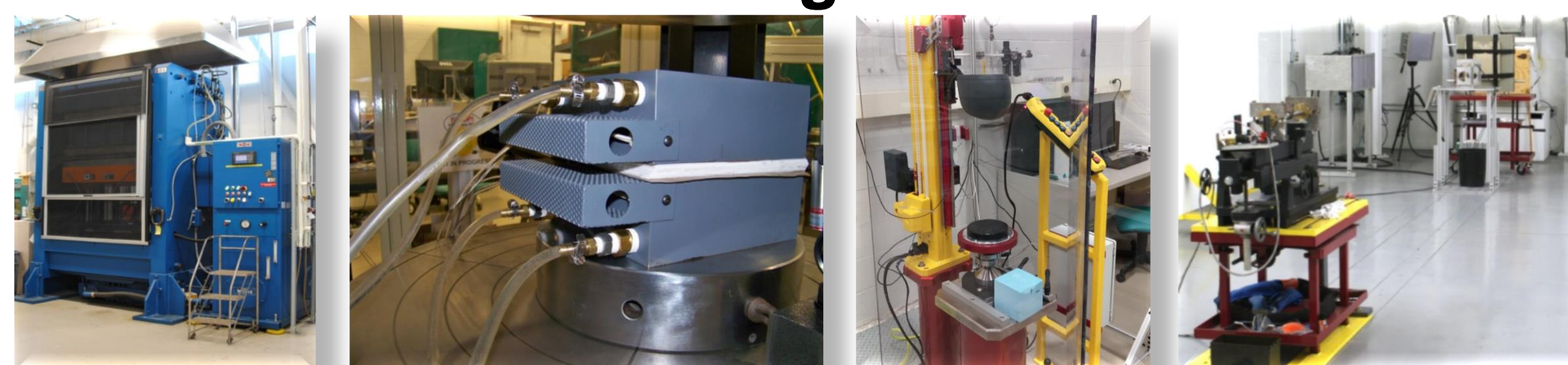
ARL Mission Focus for Head Protection Efforts

## Challenges

- Little insight of the fundamental knowledge of structure/property relationships for composite materials
- Composite models limited due to unknown composite chemistries, lack of structure/property data across all impact regimes
- Lack of understanding of the effect of materials/interfaces on stress transmission of energy in non-penetrating events, a particularly important phenomenon for understanding BABT

## ARL Facilities and Capabilities Available to Support Collaborative Research

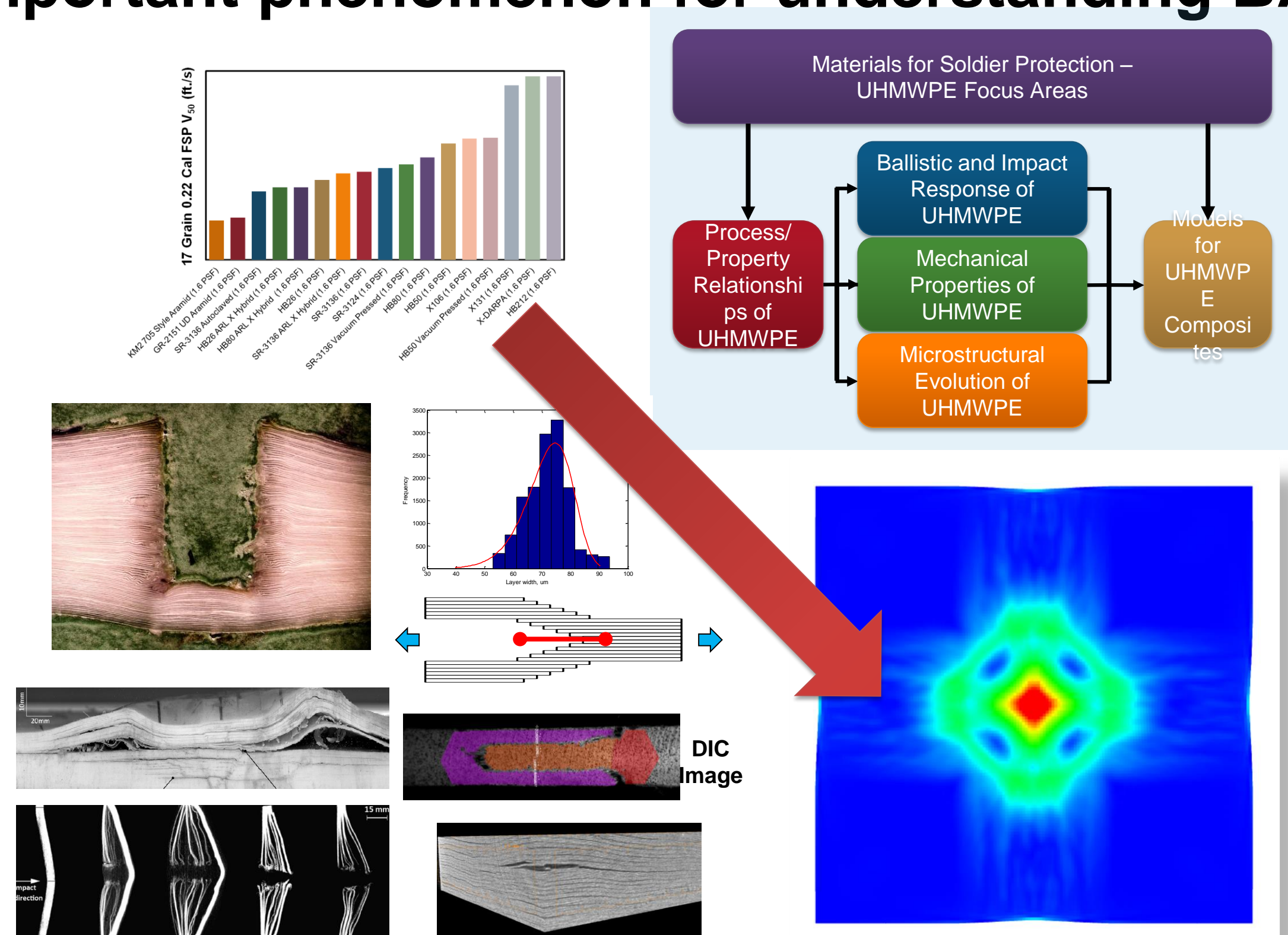
ARL is unique in that materials research can occur whilst also having the ability to test materials using mechanical test fixtures and ballistic ranges



- Full range of composite processing equipment in both lab scale and high tonnage (800 T) capacities
- Mechanical load and impact drop frames
  - FMVSS 218 drop tower for UHMWPE impact studies
  - Instrumented headform/pendulum impactor
- High resolution characterization tools, such as confocal microscopy and micro-CT
- State of the art ballistic tools at ARL SLAD ranges
  - Fragment and small arms ranges, Digital image correlation, High speed visualization, flash x-ray, CT
  - Unique tools developed at ARL for the analysis of impact-generated shock waves through materials and into surrogate tissue materials
- DoD Supercomputing Resource Center (DSRC)
- ARL recently demonstrated the mitigation of stress transmission by over six-fold through implementation of ARL X Hybrid architecture
  - Vargas-Gonzalez et al., Influence of Composite Architecture on Stress Transmittance in Ultra-High Molecular Weight Polyethylene Composite Armor, Proceedings of the 28th International Symposium on Ballistics, September 22–26, 2014, Atlanta, GA.

## Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Development of new fiber and composite materials/chemistries, modeling tools, and characterization techniques encompassing a variety of strain rates and scales.
- Researcher expertise in polymeric materials and high-strain rate behavior (elastic, viscoelastic) to develop tools for the insight of stress transmission through various materials/interfaces, in hopes of a materials-by-design approach for the mitigation of BABT.
- Expertise to develop novel approaches for Soldier protection, including load shunting technologies, rapid reconfigurable protection schemes
- Technologies for in-situ measurement of composite material properties (pressure, temperature distribution) through processing cycles
- Novel technologies and expertise for blunt impact dissipation materials and design concepts



Developing Understanding of UHMWPE through Multi-disciplinary Approach